Hampden County Memorial Bridge
Spanning the Connecticut River on Memorial Drive
Springfield
Hampden County
Massachusetts

HAER No. MA-114

PHOTOGRAPHS
WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Department of the Interior
Washington, DC 20013-7127

HAER
MASS,
7-SPRIF,
7-

HISTORIC AMERICAN ENGINEERING RECORD

HAMPDEN COUNTY MEMORIAL BRIDGE
HAER No MA-114

Location: Spanning the Connecticut River on Memorial Drive, between the City of Springfield and the Town of West Springfield, Hampden County, Massachusetts
UTM: Springfield South, Mass., Quad. 18/466335/6988400

Date of Construction: 1922

Structural Type: Seven-span reinforced concrete deck arch bridge

Engineer: Fay, Spofford & Thorndike, Boston, engineers
Haven & Hoyt, Boston, consulting architects

Builder: H.P. Converse & Company

Use: Vehicular and pedestrian bridge

Previous Owner: Hampden County, Massachusetts

Present Owner: Massachusetts Department of Public Works, Boston

Significance: The Hampden County Memorial Bridge's main span is the longest concrete deck arch span in Massachusetts. The bridge is a finely-engineered example of a rare self-supporting arch rib reinforcement technique, derived from the Melan tradition. Once encased in concrete, the steel arch reinforcing truss acts as a partner with the concrete in bearing the dead load of the structure. Although the deck is supported on spandrel columns, they are concealed behind a fascia spandrel wall, conveying the impression of a solid structure. The consulting architects, Haven & Hoyt, embellished the structure with artificial stone, notably in the four pylons of the main channel span.

Project Information: Documentation of the Hampden County Memorial Bridge is part of the Massachusetts Historic Bridge Recording Project, conducted during the summer of 1990 under the co-sponsorship of HABS/HAER and the Massachusetts Department of Public Works, in cooperation with the Massachusetts Historical Commission.

John Healey, HAER Historian, August 1990

Description

The Hampden County Memorial Bridge spans the Conncecticut River between Vernon Street in Springfield and Memorial Drive in West Springfield. The bridge was constructed between 1920 and 1922, replacing a century-old timber covered bridge some 400' upstream, which provided the city's only central river crossing.

The new bridge was constructed of reinforced concrete. The portion of the bridge crossing the river consists of seven spans, which give a combined length of 1130'-0". The main channel span, which is 176'-0" long, is not located centrally within the structure but is the third span from the city river bank. The two arches on either side of the channel span are arranged symmetrically, having spans of 154'-0" and 146'-0". The two spans at the west end are 124'-0" and 110'-0". All arches decreasing in length from the channel span shorewards. The west abutment is 50'-0" in length, and constructed of hollow-cell reinforced concrete. The eastern end of the bridge is extended by 300' as a nine-span concrete slab viaduct over the remains of formerly extensive Penn Central tracks. The arches are parabolic in form, and are comprised of five reinforced-concrete ribs. Each span carries an 80'-wide deck supported on spandrel columns rising from the inner and outer ribs, and spandrel walls supported on the outermost ribs. The arch ribs together with their wind braces and the spandrel columns and walls, together with associated deck stringers, are cast monolithically. The ribs land upon cast-steel pedestals, which are bolted to the pier skewbacks. The piers do not extend above the arch spring. The hollow piers rest on wooden piling, and are of concrete with granite facing stones.

The piers consist of non-reinforced concrete poured onto pine piles. The numbers of piles varies from 700 at pier 1, to 2,263 at the two channel piers. The coursed granite facing extends from just below the river level to a bullnose above the coping. There are ten courses of cut, rusticated granite arranged in any one course as alternating stretchers and headers. Within the coping course are set individual dressed stone skewbacks, angled to receive the ribs of the arch. Each pier has ten skewbacks, arranged to receive the five ribs that land on each side of the pier.

The ribs consist of steel parallel-chord Warren trusses of parabolic form, which are encased in concrete. They are hinged at their haunches via cast-steel bearing pedestals. Each rib contains between twenty and seventy tons of steel. The arched ribs are all 5'-6" in width, but vary in height from 4'-9" to 7'-0", according to the length of the span. Of the five ribs per arch, three are located close to the center line. The two remaining ribs are placed at the edge of the structure. The ribs are connected by wind brace beams with lattice girder reinforcement. Supplementary bar reinforcement is provided, both following the parabola of the arch, and by hoops around the rib.

The reinforcing bars of the spandrel columns are tied to the reinforcing bars of the central three ribs. The outer ribs, likewise, support the reinforcing grid for the spandrel walls. Both these elements are constructed using conventional reinforced concreting techniques. The concrete slab deck is supported on reinforced concrete stringers and transverse girders. The structure originally carried a double-track street railway at its center, to

either side were the carriageways paved with granite blocks. Twin sidewalks were provided, paved with granolithic concrete.

In addition, the granite facing of the piers various devices were employed to embellish the structure. The spandrel columns were concealed behind the spandrel wall. The concrete of the walling has a coarse texture, contrasting with the concrete of the outer rib and exposed deck, which have a rubbed finish. The outer rib is detailed with a concrete drip moulding, while the deck is finished with a pre-cast coping. That area of the spandrel walling above the pier has an artificial stone pilaster applied to maintain visual continuity with the rusticated granite below. A cartouche embellishes the crown of the channel span. Pre-cast balustrading was originally installed above the coping, but has been replaced by an art-deco style railing in wrought iron. Beacon pylons flank the channel span. They are 68' high, and feature artificial stone applied to a central reinforced concrete column. They are surmounted by decorative cast bronze lantern housings. Smaller octagonal pylons capped by a bronze spheres rise from piers 2 and 7, to mark the end of the symmetrical span.

Fay, Spofford & Thorndike

The Hampden County Memorial Bridge was designed by the Boston engineering firm of Fay, Spofford & Thorndike, which was formed in 1914. Frederic H. Fay, the senior member of the firm, had been engaged in engineering practice since completing his Master's degree in Civil Engineering, at Massachusetts Institute of Technology (M.I.T.) in 1894. He had occupied posts with the City of Boston, and was a prominent member of a number of engineering societies. Charles M. Spofford completed his post-graduate studies in engineering at M.I.T. in the same year as Fay. At the time of the bridge's construction, Spofford was Professor of Civil Engineering at Hayward. He had completed a definitive textbook on bridge engineering, and had considerable practical knowledge in the field having been employed by a Pennsylvanian steel bridge building company. Sturgis H. Thorndike graduated from the Civil Engineering program at M.I.T. in 1895. Prior to the formation of the partnership he had spent most of his career in the employ of the City of Boston.[1]

Bridge Design

Although not a unique structure, the Hampden County Memorial Bridge was described in contemporary reviews as "novel". The departure from the more usual method of bar reinforcement had both benefits and potential penalties. The bridge was designed to fine engineering tolerances, the principal aims of which were to combine both steel and concrete in a single interactive unit, in which both reached their maximum load bearing capacities. The steel latticed ribs were designed to be of sufficient strength to act as end supported arches under their own weight, together with that of the rib concrete, and the formwork necessary to pour the concrete. The ribs were erected as three hinged arches, but the central hinge was made solid after the deck had been poured.

The advantages of this form of construction, in comparison with

conventional bar reinforcement were several. At the practical level, the amount of falsework required was greatly reduced. Small amounts of falsework were only required to support the crowns of the ribs while the five ribs of any arch were being erected. No falsework was required during concreting, the formwork being bolted to the rib. The lower weight of the rib construction, compared to conventional reinforced concrete arch work, permitted savings in pier construction. As pre-fabricated units the rib steel work could be swung into place rather more speedily than in situ construction of a conventional rod reinforcing mesh. This factor was particularly important on a river subject to freshets and ice flows.

On a theoretical level, the temporary hinging of the ribs at the crown, allowed for both the stresses caused by shrinkage of the rib concrete during setting, and by dead load shortening of the interior ribs as construction proceeded. More subtly, the construction method allowed considerably greater amounts of initial stress to be developed in the structural steel ribs, compared to conventional bar work. The proportioning of material was carefully controlled to produce working stresses in both steel and concrete that were close to their respective maximum permitted limits. The design affected economy of material that could not be achieved in conventional bar reinfoecement, where the full potential strength of the steel work could not be developed. A working stress of 16,000 lbs./sq.in. was developed in the structural steel ribs where as if a bar system had been used a maximum of only 7,000 lbs./sq.in. could have been attained. As designed the steel work carries two-thirds of the dead load, the remainder being borne by the concrete. Conversely, one-third of the live load is carried by the steel, and two-thirds by the concrete. It was calculated that although the trussed rib was more expensive to construct than bar reinforcement the savings inherent in other aspects of the design conferred upon it cost advantages. The need for precision in the location of the ribs required expensive precision cut skewbacks, and steel pedestals. The most serious misgiving concerned the permanence of the bond between the structural steel work and the concrete.

The arrangements at the bridge were in a large measure determined by the navigation channel being to the city side of the river, and the insistence of the Army Corps of Engineers that they might at some future date require a draw span at this point. Additionally, consideration had to be given to state requirements for bridges carrying street railways. The latter requirement resulted in the concentration of three ribs about the center line of the bridge, the designers anticipating increases in the weight of street cars. The stipulation of the Army resulted in a channel fixed arch that was designed to be removed if required. In order to deal with the unbalanced thrust condition that would occur if the arch was removed the foundations and piers of the channel span are more substantial. The sequence of erection and concreting paid particular attention to the change in stress patterns that would occur if the main span were removed.[2]

Local History

The origins of Springfield date back to earliest colonial times, when in 1636 William Pynchon bought Indian lands in the vicinity of Chicopee. The settlement grew near the best site to ferry goods and people across The

Connecticut River. Later, the town became a major focus of highways. The north to south Connecticut Valley highway was intersected by the primary route from Massachusetts Bay to the Hudson River Valley, both crossing the river at the town. Four ferry crossings developed to serve the needs of both the local population and the traveller and merchant: the Upper Ferry on Ferry Street; the Middle Ferry at Elm Street; the Lower Ferry on York Street; and the Agawam Ferry at the southern end of the town. The major crossing for the traveller was the Upper Ferry.

The primitive road conditions were improved by the turnpiking of roads, Massachusetts approving of their establishment in 1795. By the turn of the century, the turnpike had arrived in Springfield, and provided the stimulus to construct the bridge, for which a need had been recognized for some years.

The river was first bridged at Springfield in 1805. Spanning the river at what was soon to become Bridge Street, the bridge was an open wooden structure 1234'-0" long and 30'-0" wide, and 40' above low water level. It was said to be "mongrel in style," the deck apparently rising and falling with the line of the arch. It was comprised of six spans, supported on five piers and two abutments. The work was that of the master carpenter Jonathan Walcot of Windham, Connecticut, and its cost was $36,270. The funding was provided by a lottery, and tolls were charged for the use of the bridge. Following the ravages of flood waters, the structure collapsed in 1814 under the load of a "heavy Pennsylvania Waggon." The bridge was restored in 1816, this structure being built by Isaac Damon of Northampton, Massachusetts, for $22,000, a sum also raised by lottery. The new bridge was a covered Burr-arched wooden structure. The pine for the bridge was cut in the Upper Connecticut Valley, and rafted downstream. In the spring freshet of 1818, ice wrecked all but the three western spans. The bridge was renovated, and reopened by 1820. The bridge was of great importance as a pre-railroad artery of trade. In those years 12,000 tons of freight passed across the river annually. The 1816 structure stood for the next 100 years, withstanding many great floods until it was demolished in the autumn of 1922, having been superseded by the new Memorial Bridge.

In the intervening years, the Connecticut had been crossed at three other locations in Springfield. In 1840 William Howe constructed his pioneering long span Howe truss bridge for the Western Railroad. The bridge was open, and was replaced in 1855, presumably because of rot, by a covered wooden bridge. This in turn was replaced in the 1870s by an iron truss bridge. In 1877 the North Bridge was opened, and in 1879 the South Bridge, both being for highway traffic. All three bridges were multiple intersection Warren iron truss bridges built by Leighton Bridge & Iron Company of New York.[3]

Hampden County Memorial Bridge

By the turn of the century, the old covered bridge had clearly become an anachronism. It was not until 1915, under Chapter 252 of the Acts of that year, that The Commissioners of Hampden County were authorized to construct a new bridge. The act required that a hearing "open to interested parties" be held by the County. The hearings were called from November 1915 through to January 1916. The matter of the location and dimensions of the bridge

received considerable attention, and gave the century-old bridge a reprieve. Delays were later also attributed to "the obstacles incident to the war".

Various opinions were held regarding the location of the bridge. The town of West Springfield was concerned to maintain its established street pattern, and favored a new bridge on the site of the old toll bridge. The city of Springfield having recently laid out Court Square in front of its new and grandiose City Hall, thought it fitting to complete the visual imagery with a bridge that focused on this symbol of municipal well-being. The city's preference was, therefore, Court Street, some 300 yards downstream from the old toll bridge. It was unanimously agreed that the bridge should be a high-level structure, enabling the railroad tracks on the city bank to be bridged.

On January 29, 1916 the county board appointed Fay, Spofford & Thorndike as their engineers for the project. The firm of Haven & Hoyt was retained by the engineers to advise on the architectural treatment of the bridge. In the spring of 1916 the river bed was surveyed, and thirty test bores made in a survey emmbracing all likely bridge sites. The borings indicated a hard stratum of sand and clay at depths of between 30' and 55'. In the absence of the discovery of solid rock it was pronounced that this bed provided a "practicable, though not ideal" foundation. In the light of the moderate foundation conditions a solid masonry arch was ruled out, the county having to choose between a reinforced concrete or a steel span. The perception of lower maintenance costs produced a consensus for the former.

By June 7, 1917 a report had been prepared by the county commissioners. It appears to have been designed to satisfy the demands of both West Springfield and Springfield. At the former, the bridge was to terminate at the same point as the old toll bridge, while at the latter, the civic pretensions of the city were satisfied by a crossing that "ran in a straight line directly towards the Campanile of the municipal group [of buildings]".(See Figure 1.) The consequence of this alignment would have been a bridge skewed at some 30 degrees to the river bank. On June 15, 1917 a design was submitted to the county court on the basis of the recommendations of the County Commissioners Report. The bridge was to cross from Bridge Street in West Springfield to a location between Vernon Street and Pynchon Street in Springfield. It was to be a 60'-wide reinforced concrete span, designed on the same principles as the structure that was eventually built.

Soon after the publication of the Commissioner's Report it was decided to revise its findings as "former contending factions got together, and public opinion gradually crystallized in favor of a wide bridge opposite Vernon Street, square across the river". The town of West Springfield had apparently been placated by a favorable land deal to accommodate the bridge, which opened up their shore for new developments. In spite of the new consensus on the siting of the bridge at its present location the discussions continued. Future traffic developments and their implications, particularly on the number of lanes of traffic that the bridge should be built to accommodate were the main matters of debate.

The County Commissioners published a new report in January of 1919, having held further public hearings during November of 1918. this report recommended a bridge in the location, and to the design seen today. The bridge design was said to be "dignified and appropriate to the location", the principal objectives being "to secure durability and strength", although it

had been considered "essential to secure a reasonably satisfactory appearance and finish of detail". The design featured seven arched spans across the river, together with deck spans across the railroad.(See Figure 2.) It was to be of reinforced concrete, using latticed steel reinforcement ribs. As the natural channel of the river was closer to the city bank the principal span could not be located centrally within the arched structure. Considerable thought was given to the matter of visual symmetry. It was decided that of the seven spans the two to either side of the main span should be proportioned symmetrically. The illusion of overall symmetry was to be enhanced by embellishing the ends of the main span with four prominent light pylons. The visual intergrity of the structure was to be emphasized by placing similar, though smaller pylons where the structures symmetry ceased.

The matter of the bridge's capacity had been resolved, and it was recommended that an 80'-wide deck should be built to accommodate six lanes of traffic, or four lanes of traffic together with a centrally-located street railway.[4]

The contract was let to H.P. Converse on April 3, 1920, at a price of $3,254,883. The logistics of the bridges construction were finely honed. All the various stages of construction were planned, and a sequence of erection devised. Although it is convenient to subdivide the various processes it should be noted that at any one time different stages in the process of construction would be underway; thus, while the cofferdams were in place for the pier work on the Springfield side of the river, concrete was being poured around the ribs were being swung into place on the eastern side of the bridge, the spandrel columns and walls were under construction on the opposite side of the river.[5]

The contractors established a works yard on the West Springfield bank. All construction processes began on that bank and were extended across the river to the city. Here they built a large rail supplies stroage yard, and concrete mixing plant. A trestle rail siding was constructed from which hopper rail waggons delivered sand and gravel directly to storage bins located below. A sand and gravel screening plant was installed, and dry storage provided for the cement. Sand and gravel were transferred to the mising tower by mechanised buckets on an 80-foot boom derrick. From the mising tower the aggregate and cement were mixed in ¾-yard Smith mixers. The concrete was delivered to the site by a narrow gauge railway, which crossed the river on a temporary wooden pile bridge erected 70' upstream of the main structure. The concrete was transferred from the hopper wagons to a concrete hoist tower, which floated on the river between the temporary rail bridge and the permanent structure. The steel tower was 130' high and equipped with hoisting buckets which delivered the concrete to a movable hopper. The hopper supplied an Insley steel chute that could be extended for up to 100'. These arrangements provided a flexible supply system which ensured mechanical delivery of concrete to all parts of the structure. The logistics of operation from delivery of raw materials to final pouring required thirty men, who could deliver some 450 cubic yards of concrete per day, at maximum output.[6]

Work on construction began in April of 1920. A suction dredger with revolving cutter head removed shallows in the waterway, in order that the piers should not impede the river's flow. In addition to providing a minimum water depth of 13½" in the vicinity of the bridge, the pier sites were dredged

to depths of up to 25'. Two floating pile drivers equipped with steam hammers then drove the foundation piling. A total of 10,500 piles of Delaware pine were driven to depths of between 20' and 40'. An average of 110 piles per day were driven.

After the pile driving operation were completed at any one site, cofferdams were driven around the piling to allow foundation work to continue. The dams were constructed of 6"-thick fir. The footings were built up to within 6' of low water level with concrete that was poured before the area was de-watered. The hollow piers were constructed of concrete, with wooden formwork underneath. On the exterior face the concrete was contained within the granite "facing" which was constructed one course ahead of the concrete infill. Conventional masonry laying techniques were used in the construction of the stone work. The Cape Ann Granite Company supplied the stone which was cut and numbered according to pre-determined plan at the quarry. The piers were completed by the addition of the granite skewbacks that were designed to receive the steel reinforcing ribs. Seventy skewbacks were required, there being ten to every pier. Each piece measured 5'-3" high and 5'-6" wide. Although cut to shape at the quarry, precision dressing was carried out once they were set in place. Eighty hours were spent dressing each skewback to ensure that the steel ribs were located correctly. The substructure of the bridge required 34,000 cubic yards of concrete, and 4,700 cubic yards of granite.(See Figure 3.)[7]

The trussed steel reinforcing ribs and wind braces were constructed by the McClintic-Marshall Company. The ribs were transported to the site in four-part units. The four units were riveted up into two sections prior to being swung into place by floating derrick. Falsework was only required to support the crowns of the ribs. Once the hinge pins at the skewbacks and crown were in place the ribs became self-supporting. The latticed wind brace girders were installed between the ribs of the arch. Final adjustments were made to the position of the ribs by screws in the skewback pedestals. Once the load was transferred fully to the piers, the falsework was removed.[8]

Once in place reinforcing bar was hooped about the ribs. Similarly reinforcing bars were added to the wind brace lattice. Additionally the steel bars that were to form the base of the spandrel columns were put into place. Formwork was bolted to the ribs in preparation for the pouring of the concrete. The concrete was placed around each rib during one day of continuous pouring. The concrete of each rib was poured in 20-foot sections, beginning at the piers, and alternating from one side of the span to the other. Concrete was omitted from the crown until the hinged joint of the rib rivetted up, following the installation of the deck. Within any one span the component ribs were concreted from the inside outwards. The windbracing beams were poured as part of the rib work. Between spans a particular order of erection, and concreting was specified; within a span a rib could not be concreted until the equivalent rib in the adjoining arch was erected, while in any span the number of ribs concreted could not exceed, by more than three the number previously concreted in the adjacent spans. No spandrel columns or spandrel walling was to be concreted until the flanking spans had been concreted.

The spandrel columns and walls were built using conventional reinforcing bar techniques. A slab floor was constructed upon this superstructure. Pre-

cast balustrading and artificial stone pillars, granolithic pavements completed this work.

The rib work accounted for 6,000 cubic yards of concrete. The pouring of the rib concrete began on June 13, 1921, and save for the concreting of the crown of the channel span was completed by November, when the onset of winter caused this work to be suspended. When completed 54,000 cubic yards of concrete had been used, together with 2,300 tons of structural steel, and 1,260 tons of reinforcing bar. the labor force reached a peak of 600 during the summer of 1921, and it was estimated that 108,000 man days had been expended on the bridge by the time of its completion. The total materials requirements had amounted to 12,000 railroad waggon loads.

The completion of the bridge was cause for celebration. The opening on August 3, 1922 was commemorated by a special Dedication Day in which it was named as a "Memorial" to "those who had died as pioneers, and soldiers in the Revolutionary, Civil and Foreign Wars". In spite of these higher ideals matters of the moment were more concerned with the costs of the enterprise--"New Bridge Will Go Down in History as $6,000,000 Affair". The total expenses in construction had amounted to $4,995,517.93. The principal contractor had been paid $2,738,883.86, rather less that their original quotation. Daniel O'Connell, the contractor for the earth works rceived $138,110.97. The design and site engineers, Fay, Spofford & Thorndike, received $306,572.33, the balance of the remaining expenditures were mainly accounted for by damage payments of approximately $600,000. The money was raised by temporary loans which fell due in 1924. In the intervening period the townships of Hampden County had to reach an agreement of their "assessment" towards the costs. Once the assessments had been made twenty-year bonds were issued. The 4½-percent interest payments to be made on this issue were taken into account by the Springfield Republican when it calculated the cost of the bridge to the community. The final apportionment of costs was assessed as follows: Springfield, 51 percent; West Springfield, 12 percent; Holyoke, 3 percent; Westfield, 2 percent; Agawam, 1 percent. The balance was made up by a 31-percent contribution from Hampden County, levied upon other communities in the county. The final cost was given as $6,635,214.04. Springfield was expected to make a payment of $4,412,473, the Mayor of Springfield was unhappy about the escalation of costs, and it was reported that "he sees rake-offs".[9]

The bridge was rehabilitated in 1951 by the Massachusetts Department of Public Works. All material above the deck slab was removed. The granite block road surface was replaced with bituminous concrete. The precast copings were replaced in poured concrete. The pre-cast balustrading was removed and replaced by the existing metal railings. Various other works were undertaken on the pylons.

Today the bridge is the subject of renovation proposals. It is proposed to remove and replace all exterior portions of the reinforced concrete deck of the arched spans, together with other repairs to the original superstructure where necessary. It is proposed to replace the entire superstructure, and modify the substructure of that part of the bridge that crosses the rail lines.

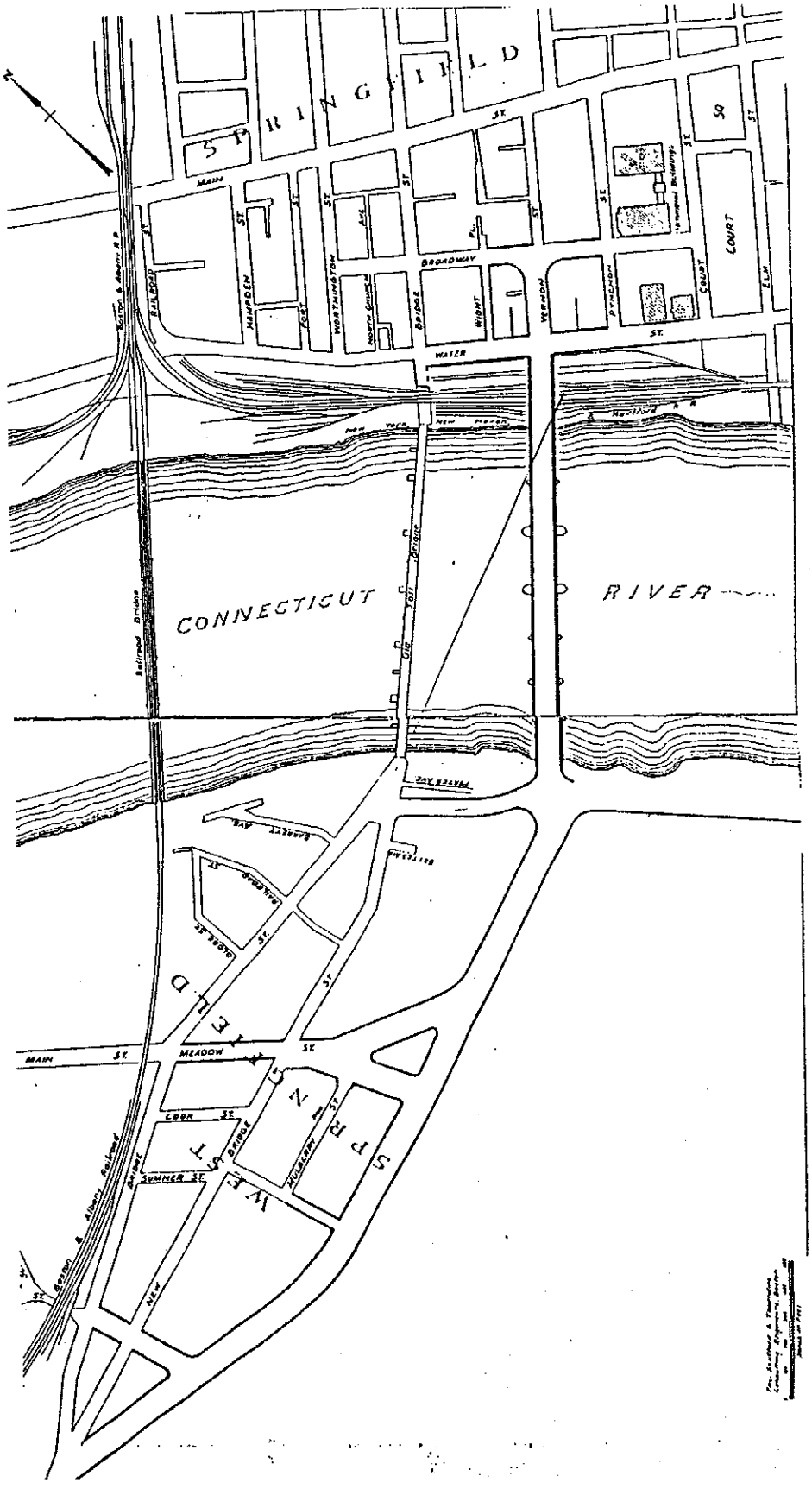
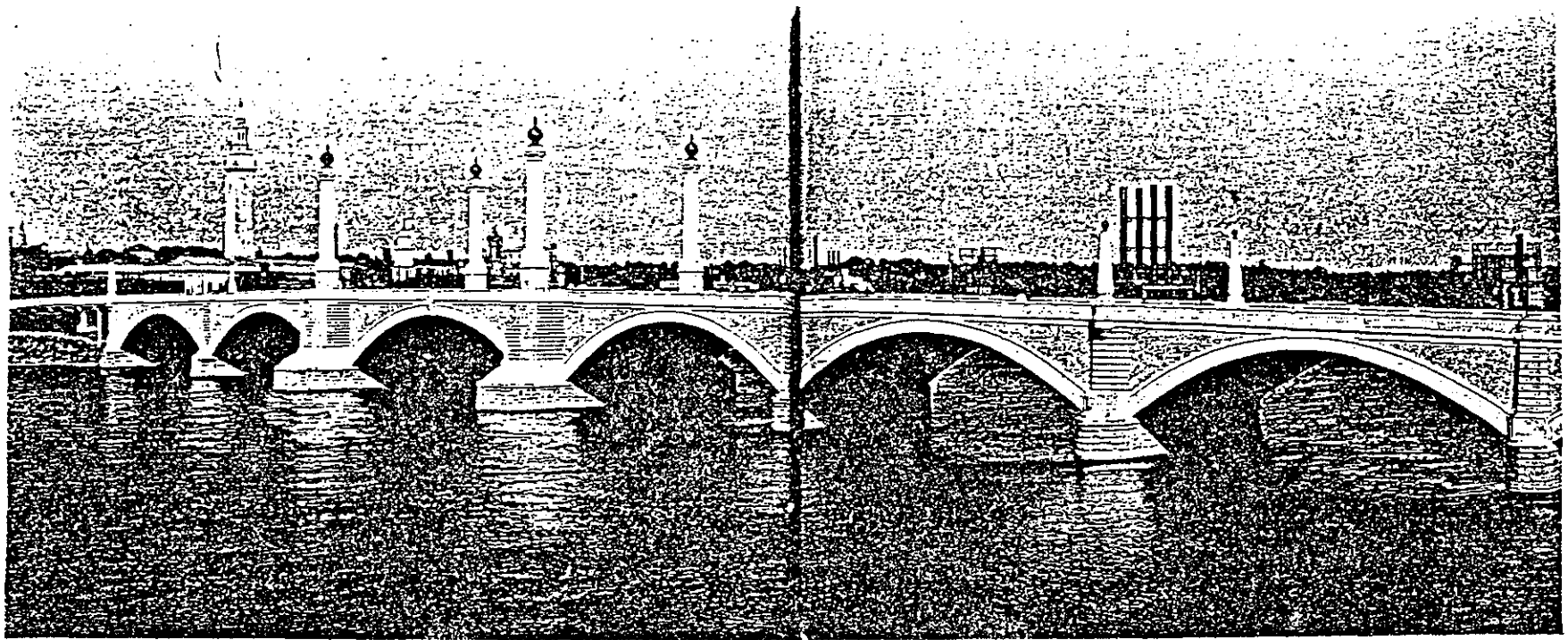


FIGURE 1: Plan from 1919 Hampden County Commissioners' Report.



HAMPDEN COUNTY MEMORIAL BRIDGE

SPANNING THE CONNECTICUT RIVER AT SPRINGFIELD, MASSACHUSETTS

FAY, SPOFFORD & THORNDIKE
DESIGNING AND SUPERVISING ARCHITECTS

H. P. CONVERSE & CO., CONTRACTORS
HAVEN & HOYT, ADVISORY ARCHITECTS

Approaches: DANIEL O'CONNELL'S SONS—ADAMS-HUTTON CONSTRUCTION CO.—GEORGE W. HAYDEN

TYPE OF BRIDGE
A highway bridge with reinforced concrete arch-ribbed spans across the river and reinforced concrete girder spans across the yard of the N. Y., N. H. & H. R. R.

HISTORY
Authorized by Chapter 252, General Acts of Massachusetts Legislature 1915.
Bridge Commission appointed Sept. 3, 1915.
Engineers appointed Jan. 29, 1916.
Bridge Contract let April 3, 1920; to be completed July 31, 1922.
Contract for bridge over river and railroad yard, $1,254,883.
Total construction cost of bridge and approaches, exclusive of land takings and damages, approximately $4,000,000.

LENGTH OF BRIDGE
Total 1500 feet (1200 feet over river and 300 feet over railroad).
Seven arch spans over river of length varying from 110 feet to 176 feet.
Nine girder spans over railroad each 33⅓ feet long.

WIDTH OF BRIDGE
Total 80 feet, consisting of roadway 60 feet wide and two sidewalks each 10 feet wide.

HEIGHT OF BRIDGE ABOVE RIVER
Clearance of channel span, 46 feet above mean low water.
Roadway of channel span, 56 feet above mean low water.
Top of towers 140 feet above mean low water.
Channel span provides for future draw if required.
Gradient of approaches 3½%; bridge built to a curved profile.

MATERIALS
Reinforced concrete with cast stone trim.
Piers faced with granite from 4 feet below mean low water to springing line of arches.
Road surfacing, granite block paving.
Sidewalk surfacing, granolithic.

FOUNDATION
Concrete on wood piles.
River bottom, coarse sand and gravel overlying hard gray clay.
Channel depth, 13 feet at mean low water

UTILITIES
Provision for double track street railway, 42 inch water main, 24 inch and 16 inch gas mains, 30 high tension electric duct lines, 30 low tension electric duct lines.

FIGURE 2: Hampden County Memorial Bridge Dedication Souvenir Program, August 8, 1922.

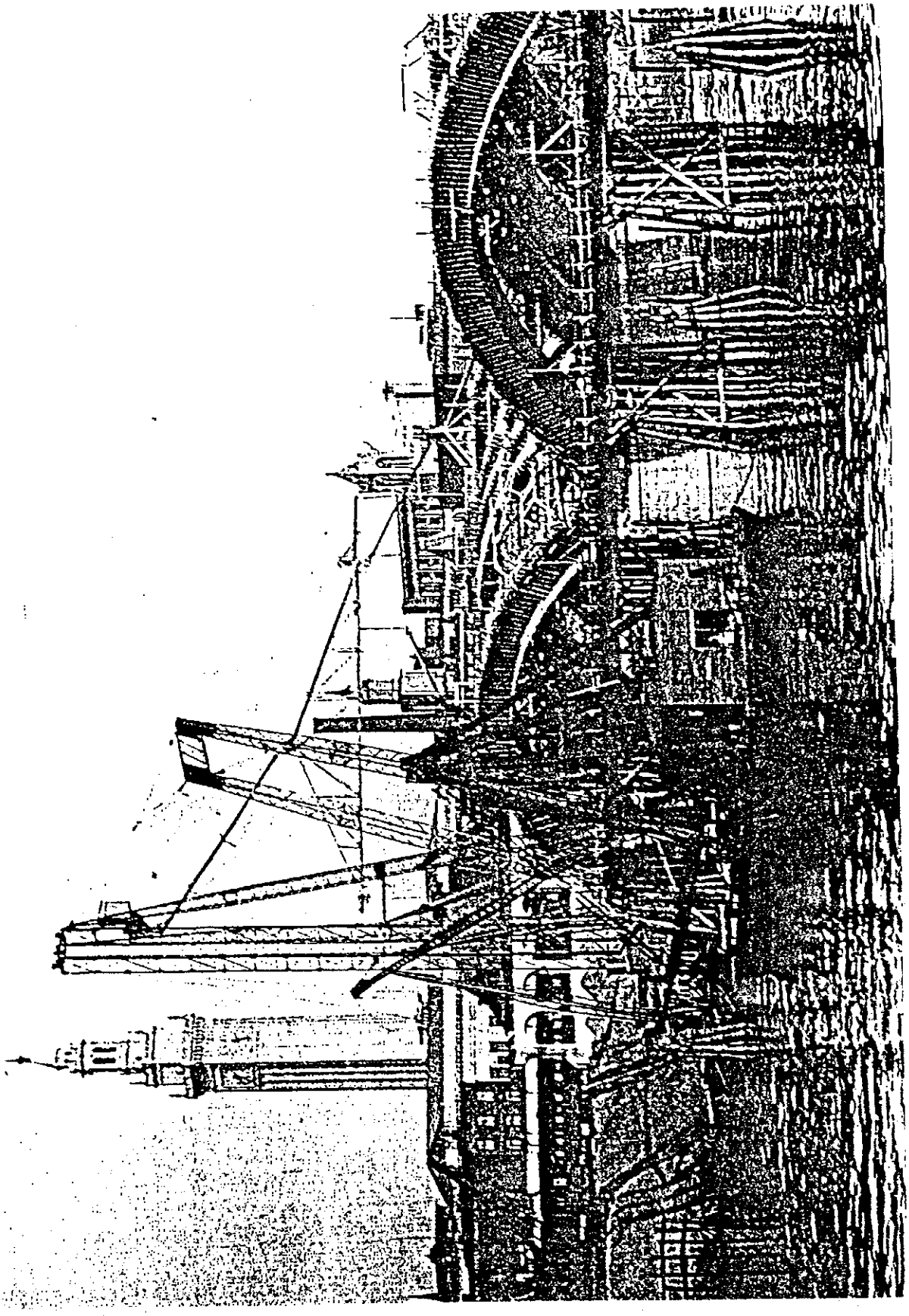


FIGURE 3: Construction photo, 1922.

ENDNOTES

1. "Engineers Who Designed the Hampden County Memorial Bridge," The Springfield Republican August 1922.

2. "Steel Reinforcement Used for Concrete Arch Centres," Engineering News-Record March 30, 1922.

3. Details of the early bridges across the Connecticut River are drawn from: Moses King, King's Handbook of Springfield, Massachusetts (Springfield, Massachusetts: James D. Gill, publisher, 1884); "Springfield Has Had Two Famous Bridges," The Springfield Republican July 30, 1922; and "Hampden County Memorial Bridge Dedication," Souvenir Program, August 3, 1922.

4. Hampden County Commissioners, Proceedings, 1917, located at the Connecticut Valley Museum Library, Springfield, Massachusetts.

5. The Connecticut Valley Museum Library has an excellent collection of photographs showing the construction process.

6. Public Works, May 27, 1922.

7. Ibid., May 20, 1922.

8. Engineering News-Record March 30, 1922, pp. 512-19; and, Public Works July 1, 1922.

9. The Springfield Republican, July 16 and 31, and August 2, 1924.

BIBLIOGRAPHY

"Engineers Who Designed the hampden County Memorial Bridge," The Springfield Republican August 1922.

Hampden County Commissioners. Proceedings, 1917-22.

"Hampden County Memorial Bridge Dedication," Souvenir Program, August 3, 1922.

Hamden County Memorial Bridge historic photograph collection, Connecticut Valley Museum Library, Springfield, Massachusetts.

King, Moses, ed. King's Handbook of Springfield, Massachusetts. Springfield, Massachusetts: James D. Gill, Publisher, 1884.

The Springfield Republican, Springfield, Massachusetts, 1922-24.

"Steel Reinforcement Used for Concrete Arch Centres," Engineering News-Record March 30, 1922.